



Small Millets in mainstream diets

Promoting Decentralised Processing Infrastructure

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In India, declining cereal diversity in diets is one of the key factors behind malnutrition and the prevalence of non-communicable diseases such as diabetes (Misra A. et al. 2011; Ruchi V. et al. 2014; Gayathri R. et al. 2016). Bringing back or inclusion of small millets in the mainstream diets could contribute to an answer. Small millets include finger, little, proso, barnyard, foxtail and kodo millets. Performing well in marginal environments they have superior nutritional properties, including high micronutrient and dietary fibre content, and low glycemic index. However, there has been a drastic decline in production and consumption of small millets in the last few decades, mainly due to limited productivity, high drudgery involved in their processing, negative perceptions of small millets as a food for the poor and policy neglect when compared to other crops.

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Did you know?

- Small millets include finger millet (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*), and barnyard millet (*Echinochloa colona*). Each of them has specific nutritional benefits.
- All small millets are rich in dietary fibre and have low glycemic index.
- Small millets are good for addressing type 2 diabetes, heart problems, constipation, other stomach disorders and obesity.
- Small millet cropping systems include many nutritious food crops like horsegram, field bean, niger, etc. and many nutritious uncultivated greens.
- Small millets are climate smart crops and can be grown in the most marginal area and can adapt to a wide range of growing environments.
- Small millets also offer highly palatable fodder for cattle.

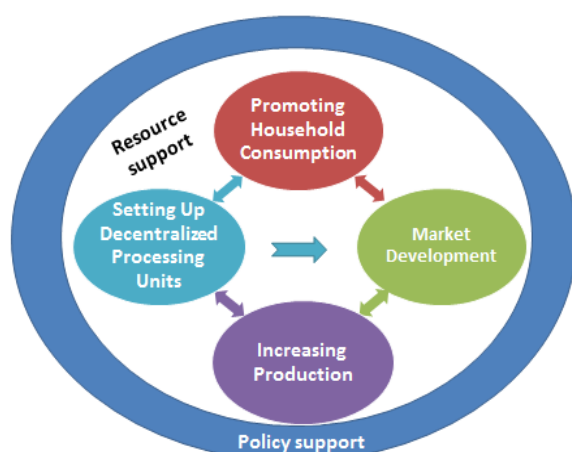
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Neglected and underutilised status of the small millets is a reflection of inadequate research on and inadequate Government support pertaining to production, processing, marketing, promotion and utilisation. The limited quantum of production has resulted in limited private investment on processing and marketing, which in turn resulted in limited number of food products in the markets, poor availability and higher prices, leading to poor demand. The market for small millet food products in terms of volume is very limited and picking up in the recent past. Product differentiation in rice and grits of small millet is yet to happen and other value added ready-to-eat and ready-to-cook products are slowly catching up in the market. Poor demand in turn is exerting a negative feedback effect on the production, processing and marketing, leading to a vicious cycle.

There is need for breaking this vicious cycle. It is only possible when comprehensive and integrated ecosystem level interventions aiming at demand stimulation through promoting household consumption, increasing production, developing decentralised processing infrastructure and local market development are taken up simultaneously

Figure 1: Conceptual framework for revalorisation of small millets



(See Figure 1) at local and regional food system levels. This paper deals with policy support needed for establishment of decentralised processing infrastructure, an important component in the overall framework for revalorisation of small millets.

Need for decentralised processing infrastructure

Dehulling is the process of removing the outer husk from the grains. It is a vital process for obtaining grain-rice and for further processing of grains for consumption. Traditionally, small millets were dehulled manually by women in the production regions and this process involves significant drudgery and time. Lack of village level processing infrastructure and high drudgery related to manual processing has resulted in drastic decline in consumption of small millets other than finger millet

in the production regions (Bala Ravi, 2004; Oliver King, 2016). Lack of regional level processing infrastructure resulted in moving out of the limited produce from the production regions to distant processing zones like Nashik, Maharashtra, thereby crowding out local consumption. Thus the price spread in the value chain is more and consequently, the price of small millet rice and other staple forms is more compared to paddy rice and wheat, making them less affordable to large number of consumers.

In these ways, inadequate availability of appropriate scale processing technology and lack of local/ regional processing infrastructure development remains as the important limiting factors for enhancing the status of small millets in mainstream diets in the local and regional food systems. For creating an environment conducive for consumption of small millets in the production areas and to transform the current positioning of small millets as 'elite food' to one of 'food for all the sections of the society', establishment of vibrant village level and regional level processing infrastructure is a key step, which addresses the critical missing link. The emergence of regional processing units in Southern India due to availability of appropriate small scale machineries has shortened the value chain thereby aiding in local and regional consumption. Similar developments need to be promoted in various other parts of the country where small millets are cultivated on a scale.

Role of Government

Role of Government is critical in promoting decentralised processing infrastructure for small millets. Given the increasing incidence of non-communicable diseases and persistence of double burden of malnutrition across the social classes and age, promoting small millets consumption can be an important instrument for the Government to address them. The need to implement Food Security Act, 2013 by the states also gives the necessary policy backdrop. Given the current status of poorly developed markets for small millets, there is need for comprehensive and integrated support in the model of 'Commodity Board' for promoting small millets as a nutritious food category. State can learn from the comprehensive support given by it to sericulture, tea, coffee, spices and coir industry to promote small millets on a scale. While there has been focused support in some parts of the country for increasing production and promoting consumption, there has been meagre support in establishing decentralised processing infrastructure and market development. The key roles of government for establishment of decentralised processing infrastructure are given in Box 1. Specific support is needed from the Government on the following aspects in an orchestrated manner:

Box 1: Role of government in establishment of decentralised processing infrastructure

1. Addressing knowledge gaps
2. Supporting initial establishment until a threshold level is reached from where the private forces take forward
3. Setting up the product standards on machineries and food products
4. Creating an environment conducive for small scale private initiatives in the small millet value chain

- 1) Addressing the research gaps in processing
- 2) Supporting establishment of a thriving ecosystem for processing equipment
- 3) Supporting establishment of local/regional processing enterprises of various scales

1. Addressing the research gaps in processing

Research on small millet processing has been quite inadequate and has been mostly limited to food processing and dehulling. For establishing small millets as a food category in the markets for wider consumption, there is need for addressing the following research gaps in the broader canvas of small millet processing:

a. Improving the primary processing equipment

While processing millets without husk (naked grains) namely sorghum, pearl and finger millets is easy, processing of millets with husk namely little, proso, kodo, barnyard, foxtail and browntop millets is difficult. These have an inedible husk which needs to be removed through processing. The major challenges in processing small millets are:

- The small size of the grains
- Variations in the raw materials due to variation in varieties, cultivation practices and microclimate and variations across the crops
- Low shelf life of the processed rice and grits due to pest infestation and rancidity

The machineries currently used for processing of small millets on a small to medium scale include, i) Graders / Shakers, ii) Destoners, iii) Air classifier / Aspirator and iv) Hullers. Currently three types of dehulling technologies are employed namely, 1. Emery mill working on abrasion principle, 2. Rubber roller mill working on abrasion principle and 3. Centrifugal type working on impact principle. Most of the components of these processing machineries are improvised version of paddy processing machineries. Small millet

processing machines are designed and manufactured by the equipment manufacturers mainly based on their experiential knowledge (trial and error method), as limited scientific research inputs have gone into the same through technology transfer. On the other hand, few resourceful processors in the market have learnt small millet processing based on large number of iterations, thereby gaining operational knowledge which is 'tacit' in nature. Limited formal research on standardizing the processing equipment as a process line has been done. There has been no effective working mechanism or learning platform for effective interaction and flow of knowledge between research institutions, equipment manufacturers and end users or to support the learning within their respective sectors. The few dehulling technologies developed are not put to test in processing units using large volumes of throughput to know their performance. The hulling efficiency (calculated as share of millet rice kernel to total grain processed) and quality of output has been less than acceptable. The presence of unhulled grains in the millet rice is an important issue faced by the consumers. On the processor side, the high cost of processing to achieve acceptable quality rice increases the price of small millet rice substantially and thereby hampers the volume of sales. Processing is the critical link in the small millet supply chain between production and consumption and therefore difficulties and inefficiencies in processing has considerable negative impact on growth of markets for small millet food products.

Therefore, there is need for fine-tuning the existing small millet processing machineries on the following aspects to improve the quantity and quality of output and to improve ease of use:

1. Optimising the dehulling technology with reference to different small millet crops and for different grades of the same millet.
2. Improving the separation mechanism in hullers to reduce removal of grits and other usable materials along with husk.
3. Improving the grader in terms of its sieving efficiency to meet pre and post-hulling segregation requirements of different small millet crops and reducing the machine foot print on the factory floor.
4. Improving the post-hulling machinery to separate unhulled from the hulled grains and to separate finer stones and mud balls similar in size and weight from rice and grits.

5. Optimising the 'process line' for village, small and medium enterprise level processing for improving the versatility, hulling efficiency, and product quality, optimising the cost of processing, and reducing pest incidence; this in turn will increase viability of the processing enterprise.
6. Reduction of the cost of the machines in the process line by reducing the foot print, height, weight and energy requirements; this will help in making them more affordable.
7. Improving the ease of use, ease of maintenance and servicing, and safety, considering the power requirements, skill requirements, and gender concerns, to reduce the downtime and to reduce the pest infestation.
8. Improving the scale of the huller to meet the processing requirements at SME level.
9. Research on multi-product process line: Currently only small millet 'rice' is considered as the primary output of the processing unit. As the market develops further, there can be requirements for more than one type of rice, grits and flour, which are differentiated in terms of quality, use and price. Research is needed for improving the 'process line' to deliver multiproduct outputs.

b. Improving the shelf life of products

The development of appropriate technologies for increasing shelf life of rice, grits/semolina and flour and value added products without compromising on quality and nutrition of the product will strengthen the small millet market significantly in the short and long term.

c. Research on product standards

The market for staple forms of small millet husked grains (rice, grits/semolina and flour) being in the initial stages, there are no standards in vogue. Following the trend in paddy rice product standards, polished small millet rice is marketed on a scale, without considering the loss of nutrients in the process. Recently unpolished and parboiled small millet rice products have started emerging in the market. There are no standards which processors have to adhere in terms of level of bran retention (polishing) and presence of broken or shattered rice kernels and rice from semi-filled grains. It is common to get rice in the market with unhulled grains, weed seeds, small stones, pest infestation, etc. All these result in poor consumer experience, which is detrimental for an emerging food product category in the short and long run. Product standards have to be

Figure 2: Output of Kodo millet at various stages of processing



evolved with the focus on nutrition and food safety for ensuring quality and for product differentiation. Developing user friendly product standards in a scientific way involving different stakeholders can help in product improvement and in product differentiation. This in turn will help to improve the consumer acceptability and product utilisation diversity.

d. Research on byproduct utilisation

Some of the by-products of small millet processing are shattered millet rice kernel of inferior quality, immature grains, husk, and husk rich flour. Enhancing utilisation of by-products through an established market, as in the case of paddy processing, will help in reducing the cost of processing to an extent.

e. Managing kodo millet poisoning

Consumption of kodo millet is sometimes found to cause intoxication and poisoning due to infection by *Aspergillus* or other microflora. Occasional incidences were reported in various parts of the country. This issue has grave consequences for promoting kodo millets on a scale. Though some investigative research has been done, there is currently no effective way to identify infection in a material. Research is needed for developing effective and easy management methods that can be deployed in the pre-processing stage.

Modus operandi for research

User centred research with a focus on nutrition, food safety and viability of enterprises is needed. Government needs to support research for addressing above mentioned research gaps by supporting a multi-stakeholder innovation platform involving research Institutions, equipment manufacturers, food industries/ enterprises, end users and facilitators like relevant state and central Government bodies and NGOs.

2. Supporting establishment of a thriving ecosystem for processing equipment

Current situation

A thriving machinery industry needs an ecosystem of its own in the manufacturing and utilization zones (crop production zones and areas where processing units are set up). For example, manufacturing zone ecosystem may have production and R&D (research and development) sub-components and the production sub-component may include availability of

accessories (like sieves) and generic fabrication facilities (like laser cutting) besides specialised production facilities. The utilization zone ecosystem may have marketing, spares provision and maintenance service provision sub-components. But manufacturing of small millet processing equipment is in its nascent stages and yet to develop many of the sub-components of the ecosystem. This is a reflection of low market demand. Small millet processing equipment manufacturing suffers from all the typical problems of small scale unregulated industry. Only small scale manufacturers supply small millet machineries as part of their business portfolio, based on order. Most of them are located in Southern India.

Challenges

The equipment are not standardised and the design vary slightly from one order to another. Operational manual is not offered to the buyers. Many custom made spares are used and machine related standards like safety standards are not adequately followed. There is limited investment on promotion of their products across India. Most of the manufacturers do not have institutional arrangements for long distance sales on a scale and for after sales service. Inadequate competition, poor research input and lack of a system for enforcement of standards aids these state of affairs.

Moving forward

What is needed is small millet processing equipment ecosystem, which offers well performing standardised machines and their spares, after sales service, and timely service in the utilisation zones. The following supports need to be given by the Government to develop small millet processing equipment ecosystem:

a. Supporting existing and new equipment manufacturers

In the short run, supporting existing equipment manufacturers to scale up their operations is a better bet as there is considerable underutilized capacity and potential for scaling up with the current equipment manufacturers. New equipment manufacturers need to be supported in other regions. The equipment manufactures need to be supported on the following aspects:

- 1) **Support for product improvement:** It needs to be done mainly through research input and user feedback. As small millet processing equipment is

an emerging market, support need to be given for easy transfer of technology from research organisations to equipment manufacturers, instead of following the current policy of fee based licensing. Offering technical training for building capacity of staff of equipment manufacturers will also be helpful. Support need to be given for in-house R & D of equipment manufacturer, as their capacity to meet the cost of R&D is limited.

- 2) **Support for product standardization:** It would involve all the necessary activities for streamlining production and after sales service like developing technical manual, product catalogue, spare parts catalogue, development of operational and maintenance manual, manpower restructuring, inventory management, etc. It is an important stepping stone for scaling up of their operations. Support for capacity building is needed on this aspect.
- 3) **Increasing volume of sales:** Lack of assured orders on a large number is a big hampering factor for further investment by the manufacturers. Only assured volume of sales will lead to the necessary breakthrough. The primary buyers are 1) entrepreneurs setting up village level mills to offer processing services, 2) small scale processors like entrepreneurs, farmers producer companies (FPOs) and 3) medium scale food industries. The first type of buyers is currently supported by NGOs or Government schemes. Support needed for increasing volume of sales are:
 - i. Placing bulk orders from Govt. schemes: Large scale government schemes like Comprehensive revival of millets in Andhra Pradesh can offer bulk orders that would trigger positive development at the manufacturer level. Offering bulk orders can be leveraged to ensure product standards, better installation and after sales services and development of local service providers.
 - ii. Facilitating linkage with potential buyers: The presence of small millet processing equipment is not known to many potential buyers like entrepreneur, NGOs and Government bodies in various parts of the country. Initial support for linkage is needed.
 - iii. Increasing visibility of products through product promotion (through website, pamphlet, etc.) and demonstration in key areas (all important

production and grain processing areas) and events (like farmer fairs, AgriExpo, large scale Govt. exhibitions) across the country.

- iv. Support in adopting different marketing strategies like online sales and identification of dealers in distant market, building on the existing machinery distribution, spare parts and servicing infrastructure for other agro-processing equipment.
- 4) **Improving production capacity:** Expansion of production facilities including necessary equipment by offering funding support at convenient terms like part grant and low interest credit, without security, etc.

b. Development of a business hub

A hub at each utilisation zone (at state or regional level) is needed for demonstration of the products, linking potential buyers to the equipment manufacturers and providing spare parts and service. This hub can be anchored either by the dealers or interested service organisations working on small millets in the initial stages.

c. Development of cadre of mechanics

This will improve the sales and will reduce the downtime for the processing units during the times of repair. It can be done by training the existing mechanics offering service to rice mills and other similar equipment by the equipment manufacturers.

d. Ensuring adherence to product standards and product services

Specific product standards related to grain processing and general product standards related to safety and ease of maintenance need to be developed and enforced by the Government. Basic services by the manufacturers like installation support, after sales service and easy access to accessories and spare parts need to be ensured. Equipment manufacturers can be persuaded to offer frequently wearing out custom made spares as part of the sale package particularly to distant markets to reduce downtime.

e. Supportive tax regime

As small millet as a food category is just emerging in the market, support is needed for promoting sale of processing equipment across the country. Tax exemptions or reduced tax will go a long way in making the small millet processing equipment more

affordable. Removing transport restrictions will also help in spreading of the technology across the states.

f. Empanelment of well-performing equipment manufacturers

A technical committee can be formed at the state/ central level by involving of end users and technical experts. This committee will identify qualified equipment manufacturers who can offer quality products at acceptable terms and will empanel them. The information on the empanelled members and the terms of service can be widely publicized, so that all the potential buyers can avail them.

3. Focused support for establishment of local/regional processing enterprises of various scales

a. Village level processing enterprises

Support needed for existing SMPUs

The primary purpose of village level processing enterprises is to offer milling services to the local population to promote consumption. Most of the current units are established by state or central Government supported schemes like INSIMP or by NGOs. They were given to interested SHGs and individuals. Most of them are running sub-optimally and good share of them are defunct. While inadequate demand in local community for processing small millet is one of the important reasons for sub-optimal functioning, the other important reasons are lack of installation for various reasons like problem in getting three phase connection, poor quality of output arising from inadequate capacity of the operators, inability to repair after break down due to lack of skilled manpower in local area, difficulties to get spare parts, and lack of funding mechanism for maintenance and repair. While these units received support for the capital cost of the machines, inadequate support was given for installation and skill building of the operator. The following supports are recommended for reviving the existing SMPUs are:

1. Servicing the existing machines
2. Installing the not yet installed unit or improperly installed equipment
3. Giving additional equipment: In most of the SMPUs only huller has been given; to improve hulling efficiency, grader and destoner can be given on a part credit and part grant basis

4. Structured capacity building for operators on machine operations as a process line and on maintenance to improve the quantum and quality of output

Support needed for new SMPUs

The new village level SMPUs can be promoted by Government as an entrepreneurial venture where support can be given as a package involving structured training (like a short time certificate course involving apprenticeship in processing unit and food enterprises along with class room sessions), preparation of business plan, start-up funding support, and support for identification

b. Regional processing enterprises

1) Establishing/ expanding production facility

In the case of existing enterprises, support is needed for additional production facilities, additional processing machineries and setting up Management Information Systems; In the case of new enterprises, support is needed for establishment of the production unit. Government support in terms of subsidy for capital investment needs to be given to the processors. The available entrepreneurship schemes of Government need to be converged on priority basis for promoting small millet processing enterprises of various scales. Setting up small scale processing units needs to be integrated as part of Integrated Tribal Development Schemes and Farmers Producer Company schemes. The government scheme of “National Mission on Food Processing” needs to be converged for this purpose.

2) Structured capacity building

Processors are in need of technical training to produce high quality small millet products at a lower processing cost in a hygienic way and entrepreneurship training to run the enterprise profitably. The technical training can cover i) floor planning, ii) assessing the raw materials, iii) organizing and operating the processing line, iv) avoiding pest infestation, v) maintenance of machines and premises, vi) product standards, vii) packing, and viii) registration and other government protocols. Out of these, ‘operating process line’ requires handholding on a periodical basis for six months to one year. These requirements for capacity building and handholding support need to be integrated within the Government support systems.

3) Building market linkages

Government can promote small millet food products through the grocery chain (like Karpagam in Tamil Nadu) run or supported by them, thereby supporting reach of critical volume of sales needed for achieving viability by small millet processors.

Government serving as bulk buyer: Government can serve as bulk buyer from the processors by introducing small millet in public food programs. On the one hand this will help processor to improve viability of enterprise, on the other hand this will give enough leverage to enforce quality standards.

4) Access to funds for working capital

Small millet crops are predominantly rainfed in nature and produced once in a crop year in most of the production regions. But processors need raw material throughout the year for their 'round the year' operations. In most of the production regions farmers sell their produce immediately after the produce at lower prices to traders to meet their cash requirements. The large traders aggregate large quantities and sell across the year at higher prices. Processors most of the time end up purchasing raw material from these traders. To partly avoid this situation, processors are in need of credit at lower interest rates to purchase during harvest from farmers or farmers' organisations and stock sufficient quantities of raw materials.

5) Creating enabling environment

- i) Reducing barriers to entry: The Government protocols to be met by the new entrepreneurs need to be made easier using digital technology development. Wherever possible online filing to be made possible
- ii) Production incentives: Incentive can be offered to processing enterprise based on actual quantum of production like cash support per quintal of rice produced; this will encourage well-functioning processing units
- iii) Ensuring product quality standards: Government needs to develop quality standards for product through multi stakeholder involvement, popularize the same among consumers and take necessary measures for adoption of these standards

Modus operandi

Single window support systems at the state level to be followed for effective implementation. One agency needs to be designated to offer an integrated support to start up enterprises focusing on small millets. That agency will coordinate with different other bodies to pool the necessary expertise and serve as single window of support to the interested entrepreneurs.

Other Government support needed at the production level

Already the primary processing of small millets is inherently challenging due to the size of the grains and variations in the raw materials. The presence of extraneous materials like mud balls, stones and dust due to threshing in the mud floor and roads complicates it further. To address this issue Government support is needed on the following aspects:

- a) Establishment of appropriate harvesting and threshing infrastructure without compromising on use of straw (for fodder and other uses) and varietal diversity
- b) Establishing threshing yards in all villages
- c) Establishment of procurement standards: This would involve educating the farmers on produce quality, linking farm gate price with produce quality and supplying simple cleaning tools

In summary

Inclusion of small millets in the mainstream diets could be one of the important ways of addressing malnutrition and non-communicable diseases such as diabetes. But, inadequate availability of appropriate scale processing technology and lack of local/ regional processing infrastructure development remains as the important limiting factors. Role of Government is critical in promoting decentralised processing infrastructure for small millets. Specific support is needed from the Government on the following aspects in an orchestrated manner:

- 1. Addressing the research gaps in processing with a focus on
 - a) Improving primary processing equipment
 - b) Improving shelf life of products
 - c) Product standards
 - d) Byproduct utilisation
 - e) Managing kodo millet poisoning

2. Supporting establishment of a thriving ecosystem for processing equipment with a focus on
 - a) Supporting existing and new equipment manufacturers
 - b) Development of a business hub
 - c) Development of cadre of mechanics
 - d) Ensuring adherence to product standards and product services
 - e) Supportive tax regime
 - f) Empanelment of well-performing equipment manufacturers
3. Supporting establishment of local/regional processing enterprises of various scales with a focus on
 - a) Establishing/ expanding production facility
 - b) Structured capacity building
 - c) Building market linkages
 - d) Access to funds for working capital
 - e) Creating enabling environment

Concerted efforts in the above mentioned aspects by Government and other stakeholders is expected to result in development of a viable decentralised small millet processing infrastructure in the medium run and establishment of small millets as a nutritious food category in the long run.

Scaling Up Small Millet Post-harvest and Nutritious Food products Project

The main objective of this action research project is to develop and apply ways for scaling up small millet processing and value addition technologies to reduce drudgery of women and improve the nutritional (and diet-related health) security in India. This project builds upon the results of two previous CIFSRF projects. The project has been taking initiatives to scale up two innovations namely i) appropriate scale small millet processing machines and ii) appealing small millet food products. It is implemented by DHAN Foundation, India and McGill University, Canada, along with Tamil Nadu Agricultural University India. This project is supported under CIFSRF by International Development Research Centre (IDRC) and Global Affairs Canada (GAC), Canada.

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